

CLAIMS

What is claimed is:

1. A method of developing computer software from an electronic spreadsheet, the
5 method comprising the computer implemented steps of:
 - coupling content in at least one cell of an electronic spreadsheet to a window; and
 - determining properties of the window based on the content in the cell of the spreadsheet.
- 10 2. A method of developing computer software according to Claim 1 wherein the step of coupling content in at least one cell of an electronic spreadsheet to a window further includes determining any graphical or functional attributes associated with the content in the cell to construct the window.
- 15 3. A method of developing computer software according to Claim 1 wherein the content in the cell of the spreadsheet corresponds to the properties of the window in that any changes to the properties of the window are reflected in the content in the cell.
- 20 4. A method of developing computer software according to Claim 1 wherein the step of coupling the content is in response to determining that an event has occurred.
- 25 5. A method of developing computer software according to Claim 4 wherein the step of determining that an event has occurred includes determining that a drag and drop event type has occurred in that the content in the cell has been dragged from the cell to the window, and subsequently dropped onto the window.

6. A method of developing computer software according to Claim 5 further includes the step of responding to the dropping of the content from the cell onto the window by:
 - (a) processing the content in the cell; and
 - 5 (b) determining the properties of the window based on the content in the cell including determining any desired behavior or any desired appearance of the window based on the content in the cell.
7. A method of developing computer software according to Claim 1 wherein the content in the cell includes any attributes associated with the cell.
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8. A method of developing computer software according to Claim 7 wherein the attributes include any input field, check box, radio button, menu object, popup menu object, label, button, combo box or list box.
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9. A computer program product comprising:

a computer usable medium which includes computer readable program instructions for developing computer software with an electronic spreadsheet by:
 - (i) processing content associated with a cell of an electronic spreadsheet;
 - (ii) connecting the content in with the cell to a window; and
 - (iii) using the content associated with the cell, determining any attributes of the window.
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- 25 10. A computer program product according to Claim 9 wherein the instructions for connecting the content associated with the cell to a window further include instructions for assembling any graphical or functional attributes associated with the content in the cell to construct the window.

11. A computer program product according to Claim 9 wherein the instructions for connecting the content associated with the cell to a window are in response to receiving an indication that an event has occurred.
- 5 12. A computer program product according to Claim 11 wherein receiving an indication that an event has occurred includes determining that a drag and drop event type has occurred such that the content associated with the cell is dragged from the cell to the window, and subsequently dropped onto the window.
- 10 13. A computer program product according to Claim 12 further includes instructions that respond to the dropping of the content onto the window by:
 - (a) processing the content associated with the cell; and
 - (b) determining the attributes of the window based on the content associated with the cell including determining any desired behavior or any desired appearance of the window.
- 15 14. A computer program product according to Claim 9 wherein the content associated with the cell includes any data objects associated with the cell.
- 20 15. A computer program product according to Claim 14 wherein the data objects associated with the cell include any input field, check box, radio button, menu object, popup menu object, label, button, combo box or list box.
16. An apparatus for developing computer software using an electronic spreadsheet, the apparatus comprising:
 - 25 (a) an electronic spreadsheet having at least one input cell;
 - (b) instructions in the cell; and
 - (c) a window which reflects the instructions in the cell.
- 30 17. An apparatus according to Claim 16 further including an assembly which:

processes the instructions in the cell; and
connects the instructions from the cell to the window.

18. An apparatus according to Claim 17 wherein the assembly connects the
5 instructions to the window in response to receiving an indication that an event
has occurred.
19. An apparatus according to Claim 18 wherein receiving an indication that an
event has occurred includes determining that a drag and drop event type has
10 occurred where the instructions in the cell are dragged from the cell to the
window, and subsequently dropped onto the window to construct the window.
20. An apparatus according to Claim 19 wherein the assembly responds to the
dropping of the instructions onto the window by:
15 processing the instructions in the cell; and
determining the attributes of the window based on the instructions in the
cell to define a behavior or appearance for the window.
21. An apparatus according to Claim 16 wherein the instructions in the cell describe
20 attributes associated with the cell.
22. An apparatus according to Claim 21 wherein the attributes include any input
field, check box, radio button, menu object, popup menu object, label, button,
combo box or list box.
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23. A system to develop computer software in a spreadsheet application, the system
comprising:
a means for coupling instructions associated with at least one cell of an
electronic spreadsheet to a window; and

a means for determining properties of the window based on any instructions associated with the cell of the spreadsheet.

24. An object-oriented computer programming method, the method comprising the computer implemented steps of:
 - 5 representing an object in an object-oriented programming language with a respective spreadsheet, the spreadsheet having at least one cell storing instructions for the object; and
 - 10 processing the object based on the instructions stored in the cell of the respective spreadsheet.
25. A method as claimed in Claim 24 further comprises the step of identifying a hierarchy of parent and child objects, each object being represented by a respective spreadsheet, where the spreadsheet representing a parent object is a parent spreadsheet, the spreadsheet representing a child object of the parent object is a child spreadsheet, and the child spreadsheet inherits instructions from the parent spreadsheet.
26. A method as claimed in Claim 24 wherein the instructions further include an operation which is processed when the object interacts with another object.
27. A method as claimed in Claim 24 wherein the instructions further include any event, operation, message, function, command, formula, loop or variable.
- 25 28. A computer program product comprising:
 - a computer usable medium having computer readable program instructions for developing object-oriented computer software using an electronic spreadsheet by:

defining an object in an object-oriented programming language using a respective spreadsheet, the spreadsheet having at least one cell including content for the object; and
determining the behavior of the object based on the content included in the cell of the respective spreadsheet.

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29. A computer program product as in Claim 28 further include instructions for identifying a hierarchy of parent and child objects, each object being defined by a respective spreadsheet, such that the spreadsheet defining a parent object is a parent spreadsheet, the spreadsheet defining a child object of the parent object is a child spreadsheet, and the child spreadsheet inherits content associated with the parent spreadsheet.
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30. A computer program product as in Claim 28 further including instructions for sending a message to another object by processing an operation.
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31. A computer program product as in Claim 28 wherein the content in the cell includes at least one of: an event, operation, message, function, command, formula, loop and variable.
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32. A spreadsheet apparatus for object-oriented programming comprising:
 - an electronic spreadsheet which represents an object defined in an object defined in an object-oriented programming language; and
 - at least one input cell in the spreadsheet having information about the object.
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33. A spreadsheet apparatus for object-oriented programming as in Claim 32 which further includes a hierarchy of parent and child objects, each object being represented by a respective spreadsheet, where the spreadsheet representing a parent object is a parent spreadsheet, the spreadsheet representing a child object
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of the parent object is a child spreadsheet, and the child spreadsheet inherits information from the parent spreadsheet.

34. A spreadsheet apparatus for object-oriented programming as in Claim 32
5 wherein the information about the object includes at least one of: an event, operation, message, function, command, formula, loop and variable.
35. An object-oriented programming system with an electronic spreadsheet interface, the system comprising:
 - 10 a means for representing an object in an object-oriented programming language with a respective spreadsheet, the spreadsheet having at least one cell storing instructions for the object; and
 - 15 a means for processing the object based on the instructions stored in the cell of the respective spreadsheet.
36. A computerized method of developing object-oriented software from an electronic spreadsheet, the computerized method comprising:
 - 20 defining a class in an object-oriented programming language by creating a respective spreadsheet.
37. A computerized method as described in Claim 36 further includes creating an object associated with the class when the respective spreadsheet is created.
- 25 38. A computerized method as described in Claim 36 wherein the respective spreadsheet includes cells that have information and operations for the class.
39. A computerized method as described in Claim 36 further includes identifying a hierarchy of parent and child objects, each object being represented by a respective spreadsheet, in that the spreadsheet representing a parent object is a parent spreadsheet, the spreadsheet representing a child object of the parent
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object is a child spreadsheet, and the child spreadsheet inherits information from the parent spreadsheet.

40. A computerized method as described in Claim 36 further comprising:
 - 5 using an object-oriented programming operation defined in the respective spreadsheet, sending a message to an object.
41. A computerized method as described in Claim 36 further includes determining a behavior of an object based on any information stored in the respective spreadsheet; and
 - 10 wherein the information stored in the respective spreadsheet includes any: event, operation, message, function, command, formula, loop and variable.
42. A computer program product comprising:
 - 15 a computer usable medium having computer readable code developing object-oriented software using an electronic spreadsheet by:
 - defining a class in an object-oriented programming language by creating a respective spreadsheet.
- 20 43. A computer program product as described in Claim 42 further includes code that defines an object associated with the class when the respective spreadsheet is created.
44. A computer program product as described in Claim 42 wherein the respective spreadsheet includes cells that have information and operations for the class.
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45. A computer program product as described in Claim 42 further includes code that identifies a hierarchy of parent and child objects, each object is represented by a respective spreadsheet, where the spreadsheet representing a parent object is a parent spreadsheet, the spreadsheet representing a child object of the parent
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object is a child spreadsheet, and the child spreadsheet inherits information from the parent spreadsheet.

46. A computer program product as described in Claim 42 further comprising code
5 that enables messaging between objects by processing an operation defined in the respective spreadsheet.
47. A computer program product as described in Claim 42 further includes code for determining a behavior of an object based on information stored in the
10 respective spreadsheet; and wherein the information stored in the respective spreadsheet includes any: event, operation, message, function, command, formula, loop and variable.
48. An apparatus with an electronic spreadsheet interface for developing object-
15 oriented software comprising:
a class defined in an object-oriented programming language in response to creating an electronic spreadsheet.
49. An apparatus as described in Claim 48 further including an object associated
20 with the class, the object being defined by the respective spreadsheet.
50. An apparatus as described in Claim 48 wherein the respective spreadsheet includes cells that have information and operations for the class.
- 25 51. An apparatus as described in Claim 48 further includes a hierarchy of parent and child objects, each object being defined by a respective spreadsheet, where the spreadsheet defining a parent object is a parent spreadsheet, the spreadsheet defining a child object of the parent object is a child spreadsheet, and the child spreadsheet inherits information from the parent spreadsheet.

52. An apparatus as described in Claim 48 wherein the class defines an operation in an object-oriented programming language which is used to communicate between objects.
- 5 53. An apparatus as described in Claim 48 further includes logic for determining a behavior of the object based on information stored in the spreadsheet; and wherein the information stored in the spreadsheet includes an event, operation, message, function, command, formula, loop or variable.
- 10 54. An object-oriented programming system using an electronic spreadsheet, the system comprising:
 - a means for defining a class by creating a respective spreadsheet.
- 15 55. A method of providing text editor functionality in an electronic spreadsheet, the method comprising the computer implemented steps of:
 - defining a code column in an electronic spreadsheet; and
 - responding to a request for a newline by inserting a new cell in the code column.
- 20 56. A method according to Claim 55 wherein the code column further includes text editor functionality in that the code column behaves as a text editor.
57. A method according to Claim 56 wherein the request for a newline occurs when a keystroke input is received while a cell in the code column is selected.
- 25 58. A method according to Claim 57 further includes:
 - inserting the new cell below the selected cell;
 - moving cells positioned below the selected cell to create space for the new cell; and
- 30 30 correcting any references to the cells which are moved.

59. A method according to Claim 55 wherein the code column further includes scroll bars.
- 5 60. A method of computer programming according to Claim 58 wherein the scroll bars enable scrolling through the code column independent of any scrolling of the spreadsheet.
- 10 61. A computer program product comprising:
 - 10 a computer usable medium having computer readable program instructions which implement a computer programming environment in an electronic spreadsheet by:
 - 15 creating a code column in an electronic spreadsheet; and
 - responding to a request for a newline by introducing a new cell in the code column.
62. A computer program product according to Claim 61 wherein the code column provides text editor functionality.
- 20 63. A computer program product according to Claim 62 wherein the request for a newline is determined in response to receiving a keystroke input while a cell in the code column is selected.
64. A computer program product according to Claim 63 further includes instructions for:
 - 25 inserting the new cell below the selected cell;
 - adjusting cells positioned below the selected cell to provide space for the new cell; and
 - 30 in a cell that includes a reference to one of the adjusted cells, correcting the reference.

65. A computer program product according to Claim 62 wherein the code column further includes scroll bars.
- 5 66. A computer program product according to Claim 62 wherein the scroll bars enable scrolling through the code column independent of any scrolling of the spreadsheet.
- 10 67. An apparatus for developing computer software from an electronic spreadsheet comprising:
 - a code column in an electronic spreadsheet that responds to a request for a newline by introducing a new cell in the code column.
- 15 68. An apparatus according to Claim 67 wherein the code column is a text editor in a column of the spreadsheet.
69. An apparatus according to Claim 67 wherein the request for a newline occurs when a keystroke input is received while a cell in the code column is selected.
- 20 70. An apparatus according to Claim 67 further includes logic for:
 - inserting the new cell below the selected cell;
 - adjusting the position of the cells below the selected cell to account for the new cell; and
 - updating a reference to one of the adjusted cells to reflect a new position for the adjusted cell
- 25 71. An apparatus according to Claim 67 wherein the code column in the spreadsheet includes scroll bars which enable scrolling through the code column independent of any scrolling of the spreadsheet.

72. A system for developing computer software in an electronic spreadsheet comprising:
a means for defining a code column in an electronic spreadsheet; and
a means for responding to a request for a newline by inserting a new cell
5 in the code column.

73. A computerized method of object-oriented programming in an electronic spreadsheet system, the computerized method comprising:
in an electronic spreadsheet, creating an operation written in an object-oriented programming language; and
10 using the operation, interacting with another spreadsheet.

74. A method according to Claim 73 further comprising:
in response to receiving a message from an object, processing the
15 operation.

75. A method according to Claim 73 wherein the spreadsheet is used to define an object written in an object-oriented programming language.

20 76. A method according to Claim 75 further includes:
determining a behavior of the object based on any information stored in the spreadsheet; and
wherein the information stored in the respective spreadsheet includes
any: event, operation, message, function, command, formula, loop and variable.
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77. A method according to Claim 73 further includes determining a hierarchy of parent and child objects, each object being represented by a respective spreadsheet, in that the spreadsheet representing a parent object is a parent spreadsheet, the spreadsheet representing a child object of the parent object is a

child spreadsheet, and the child spreadsheet inherits information from the parent spreadsheet.

78. A computer program product comprising:
 - 5 a computer readable medium having computer readable instructions that enable object-oriented computer software development using an electronic spreadsheet by:
 - 10 creating an operation written in an object-oriented programming language with a spreadsheet, the operation being used to interact with one or more objects.
79. A computer program product according to Claim 78 wherein the operation is processed when an object receives a message.
- 15 80. A computer program product according to Claim 78 wherein the spreadsheet represents an object written in an object-oriented programming language.
81. A computer program product according to Claim 80 further includes instructions that:
 - 20 determine a behavior of the object based on any information stored in the spreadsheet; and
 - wherein the information stored in the respective spreadsheet includes any: event, operation, message, function, command, formula, loop and variable.
- 25 82. A computer program product according to Claim 78 further include instructions that create a hierarchy of parent and child objects, each object being represented by a respective spreadsheet, where the spreadsheet representing a parent object is a parent spreadsheet, the spreadsheet representing a child object of the parent object is a child spreadsheet, and the child spreadsheet inherits information from the parent spreadsheet.

83. An apparatus for developing object-oriented computer software comprising:
 - 5 an electronic spreadsheet which creates an operation written in an object-oriented programming language, the operation being used to interact with one or more objects.
84. An apparatus according to Claim 83 wherein the operation is processed when an object receives a message.
- 10 85. An apparatus according to Claim 83 further includes logic that:
 - 15 determines a behavior of an object based on any information stored in the spreadsheet; and
 - wherein the information stored in the respective spreadsheet includes any: event, operation, message, function, command, formula, loop and variable.
- 15 86. An apparatus according to Claim 83 further includes logic to identify a hierarchy of parent and child objects, each object being represented by a respective spreadsheet, such that the spreadsheet representing a parent object is a parent spreadsheet, the spreadsheet representing a child object of the parent object is a child spreadsheet, and the child spreadsheet inherits information from the parent spreadsheet.
- 20 87. A data processing system for developing computer software using an electronic spreadsheet, the system comprising:
 - 25 a means for using a spreadsheet to create an operation written in an object-oriented programming language; and
 - a means for interacting with another spreadsheet by processing the operation

88. A method of programming with an electronic spreadsheet, the method comprising the computer implemented steps of:
 - defining cells in a spreadsheet that are associated with an iterative process repeating for one or more cycles; and
 - 5 at each cycle, determining whether to modify content in the cells associated with the iterative process.
89. A method of programming with an electronic spreadsheet as in Claim 88 wherein at least one of the cells associated with the iterative process includes a final value cell, and at least one of the cells includes an initial value cell, where a value in the final value cell is used to modify a value in the initial value cell.
- 10 90. A method of programming with an electronic spreadsheet as in Claim 88 wherein the iterative process is repeated for either a fixed number of times or 15 until a condition defined in a condition cell no longer applies, or begins to apply.
91. A computer program product comprising:
 - a computer readable medium having computer program code which enables computer programming with an electronic spreadsheet by:
 - 20 defining cells in a spreadsheet that are associated with an iterative process repeating for one or more cycles; and
 - at each cycle, determining whether to modify content in the cells associated with the iterative process.
- 25 92. A computer program product as in Claim 91 wherein at least one of the cells associated with the iterative process includes a final value cell, and at least one of the cells includes an initial value cell, where a value in the final value cell is used to modify a value in the initial value cell.

93. A computer program product as in Claim 91 wherein the iterative process is repeated for either a fixed number of times or until a condition defined in a condition cell no longer applies, or begins to apply.
- 5 94. An apparatus for programming using an electronic spreadsheet comprising:
 - a spreadsheet having cells that are associated with an iterative process repeating for one or more cycles; and
 - content in the spreadsheet being modifiable by the iterative process.
- 10 95. An apparatus as in Claim 94 wherein the modifiable content further includes:
 - at least one of the cells associated with the iterative process is a final value cell;
 - at least one of the cells associated with the iterative process is an initial value cell; and
- 15 a value in the final value cell which influences a value in the initial value cell in each cycle of the iterative process.
96. An apparatus as in Claim 94 wherein the iterative process is repeated for either a fixed number of times or until a condition defined in a condition cell no longer applies, or begins to apply.
- 20 97. A data processing system for programming using an electronic spreadsheet, the system comprising:
 - a means for defining cells in a spreadsheet that are associated with an iterative process that repeats for one or more cycles; and
 - 25 at each cycle, a means for determining whether to modify content in the cells associated with the iterative process.